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Design Criteria Monograph for Valve Components

A design criteria monograph has been published which is a summary and a systematic ordering of the large and loosely organized body of existing successful design techniques and practices for the design of liquid rocket valve components.

This monograph was written to organize and present, for effective use in design, the significant experience and knowledge accumulated by NASA in development and operational programs. It reviews and assesses current design practices, and from them establishes firm guidance for achieving greater consistency in design, increased reliability in the end product, and greater efficiency in the design effort.

The advent of the liquid rocket engine necessitated technological advances in the design of valve components to meet the requirements of low weight, small size, high pressure, high flow, low leakage, high cycle life, and high reliability. Valve design technology has advanced, but not without attendant problems. The monograph treats these problems as they were solved in the successful development of flightweight operational valves for liquid rocket systems. Practices and procedures for the design of valving elements, seats, seals, housings, shafts, shaft seals, and bearings are discussed in detail. General practices for cleaning and contamination prevention are summarized. Information on valving element and seat or seal interfaces is indexed by specific valve type (poppet, butterfly disk, ball, blade, sleeve, and cylindrical slide), since the detail design requirements for each type of valving element and its seat or seal vary widely. The balance of information is arranged by topic, since the detail design requirements for housings, bearings, shafts, and shaft seals and the problems of contamination and vibration apply to most types of valves. Specific design requirements arising from the particular use of a valve are discussed. Lapping techniques are treated briefly, because lapping is a critical manufacturing operation that is not always well understood and is not well documented.

The monograph comprises two major sections: State of the Art, and Design Criteria and Recommended Practices. References complement the text.

The State-of-the-Art section reviews and discusses the total design problem, and identifies the design elements

that are involved in successful design. The Design Criteria state clearly and briefly each rule, guide, limitation, or standard that must be imposed on each essential design element to assure successful design; the Recommended Practices set forth the best available procedures for satisfying the Design Criteria.

Both major sections are divided into twelve subject categories: poppet valving unit; butterfly disk valving unit; ball valving unit; blade valving unit; sleeve valving unit (rotary and linear sleeve); cylindrical slide valving unit (spool and cylindrical); general considerations in valving unit design (vibration and contamination); shaft; housing; bearings (guide, journal, rolling-contact, thrust); secondary seals (o-rings, lip seals, face seals, bellows, sleeve seals); and materials.

This thorough review of design criteria and practices relative to valve components should be of value to designers and manufacturers of these devices and to designers and manufacturers of associated equipment.

Notes:

1. This monograph has been published as the following report:

NASA SP-8094 (N74-27276), Liquid Rocket Valve Components

Copies may be obtained at cost from:

Aerospace Research Applications Center
Indiana University
400 East Seventh Street
Bloomington, Indiana 47401
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Reference: B74-10087

2. Specific technical questions may be directed to:

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Category 06